Final Sampling and Analysis Plan

Powder River, Tongue River, Rosebud Creek TMDL Planning Areas

June 18, 2003

Prepared for the Montana Department of Environmental Quality by Tetra Tech, Inc.
Technical support and direction provided by the U.S. Environmental Protection Agency

DEQ Project Manager: Art Compton

EPA Project Manager: Ron Steg

Tetra Tech Inc. Project Manager: Kevin Kratt

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1.0 INTRODUCTION

Stream segments designated as "water quality impaired" or "threatened" are listed on Montana's 303(d) list and require the development of Total Maximum Daily Loads (TMDLs). On September 21, 2000, the United States District Court of Montana ordered the U.S. Environmental Protection Agency (USEPA) to work with the Montana Department of Environmental Quality (MDEQ) to develop and adopt a schedule to develop all necessary TMDLs for waters on Montana's 1996 Section 303(d) list by May 5, 2007. See, *Friends of the Wild Swan, Inc. et al.*, vs. *U.S. Environmental Protection Agency*, CV 97-35-M-DWM. In accordance with the original schedule, all necessary TMDLs for the Tongue River, Powder River, and Rosebud Creek watersheds in Montana were to be completed by December 31, 2006. However, the MDEQ has decided to accelerate the schedule for these watersheds to facilitate coordination between the TMDL program and ongoing efforts relative to development of coal-bed methane (CBM). The final target date for completion of all necessary TMDLs for these watersheds is December 31, 2003.

Comprehensive assessments of all available data in these three watersheds have been completed and documented in previous reports. The results indicate that additional data are needed to facilitate the completion of the TMDLs for the Tongue River, Powder River, and Rosebud Creek TMDL Planning Areas (TPAs). The Sampling and Analysis Plan (SAP) outlined in this document describes a monitoring and sample collection plan to evaluate water quality and beneficial uses in the TPAs. Targeted streams and associated potential causes of impairment are shown in Table 1-1.

In 2003, extensive monitoring will be conducted in all of the targeted segments to assess the chemical, physical, and biological characteristics of these waterbodies and confirm the need for TMDL development. Information will also be collected to better estimate the loadings from the various sources. Monitoring will occur between March and September of 2003. Information that follows in this SAP provides the detail necessary to implement the monitoring plan. This document is organized into three sections: Methods, Stream Monitoring, and Tongue River Reservoir (TRR) Monitoring.

Table 1-1. Evaluated causes of impairment in the Tongue River, Powder River, and Rosebud Creek TPAs.

Segment	Algal Growth/ Chlorophyll-a	Bank erosion	Chlorides	Metals	Nutrients	Organic Enrichment/DO	Other Inorganics	Pathogens	Salinity	SAR	Siltation	Suspended Solids	TDS	Thermal Modifications
Tongue River Watershed														
Lower Tongue River			x	x			x		x	x		x	x	
Middle Tongue River			x	x			x		x	x		x	x	
Upper Tongue River			x	x					x	x			x	
Tongue River above the Reservoir			x	x					x	x			x	
Hanging Woman Creek			x	x			x		x	x	x	x	x	
Otter Creek			x	x					x	x		x	x	
Pumpkin Creek			x						x	x			x	x
Tongue River Reservoir	x		x		x	x			x	x		x	x	
Powder River Watershed														
Lower Powder River			x	x	x		x	x	x	x		x	x	
Upper Powder River			x	x	x		x	x	x	x		x	x	
Little Powder River			x				x		x	x	x	x	x	
Mizpah Creek			x			x	x		x	x		x	x	
Stump Creek			x						x	x		x	x	
Rosebud Creek Watershed														
Lower Rosebud Creek		x	x	x	x		x		x	x		x	x	
Middle Rosebud Creek			x	x	x		x		x	x		x	x	
Upper Rosebud Creek			x	x	x		x		x	x		x	x	

2.0 METHODS

This SAP contains information necessary to understand what, where, when, and how data will be collected for the monitoring events described herein. Guidance documents cited below describe the methods necessary to complete the monitoring outlined in this SAP. These documents include:

- Montana Water Quality Monitoring Standard Operating Procedures (SOP) (available at http://www.deq.state.mt.us/ppa/mdm/SOP/sop.asp), specifically sections:
    - 10.0 – Sample Collection
    - 11.0 – Methods for Collecting, Analyzing, and Reporting Water Quality and Sediment Chemical Data
    - 12.0 – Methods of Assessing the Biological Integrity of Surface and Groundwater
    - 13.0 – Methods for Assessing the General Health and Physical Integrity of Surface Waters.
- Stream Channel Reference Sites: An Illustrated Guide to Field Technique (U.S. forest Service) (available at http://www.stream.fs.fed.us/publications/documentsstream.html).
- USEPA's Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (Second Edition) (USEPA, 1999).

Monitoring in the Tongue River, Powder River, and Rosebud Creek watersheds will follow the guidance provided in these documents. Monitoring is expected to include the following components:

- Water quality monitoring
- In situ monitoring
- Biological surveys – benthic macroinvertebrates and periphyton
- Physical surveys – habitat quality assessments and stream channel conditions

3.0 STREAM MONITORING

The sections below describe the sampling and analysis plan for streams in the Powder River, Rosebud Creek, and Tongue River watersheds. The sections are organized by parameter. In general, additional chemical, biological and physical data are needed to address data gaps and sources of pollutants, and to facilitate watershed modeling. In some cases, additional data are not required because sufficient data has already been collected, or will be collected by other agencies in 2003 (see the Tongue River, Powder River, and Rosebud Creek TMDL Status Reports). A summary of the recommended monitoring stations and the associated monitoring efforts are summarized in Appendix A (Table A-1). A timeline for the 2003 monitoring plan is also included in Appendix A (Table A-3).

3.1 Monitoring Locations

All monitoring locations were selected based on current understanding of the sites using available physical information from various maps and GIS data. Preliminary monitoring station selections were further made on the basis of historical water quality data, land use, and apparent accessibility. Table 3-1 summarizes the monitoring stations for the 2003 sampling program. The locations of each station are shown in Appendix B. Water quality, in situ monitoring, and flow monitoring stations are point locations where monitoring activities will be conducted at a specified location. Supplemental physical and biological characterizations will be conducted at identified locations and will have an associated length of stream within which these assessments will be conducted. However, because the length of stream is dependent on stream width, actual reach lengths cannot be reported at this time.

The USGS will also be monitoring several sites in the Tongue River, Powder River, and Rosebud Creek in 2003 (Table A-2). Discharge, precipitation, temperature, and salinity (EC) are monitored by USGS at several real-time continuous monitoring sites. USGS also collects regularly scheduled grab samples at additional stations. The type and amount of sampling varies at each USGS station, and some supplemental sampling will occur at several sites to fill identified data gaps. A summary of the USGS monitoring sites is included in Appendix A, and the sites are shown in the maps included in Appendix B.

Table 3-1. Monitoring stations for the 2003 sampling program.

Site ID	STORET ID	Site Type	Description	Latitude	Longitude	Drainage Area (mi^2)
Powder River Watershed						
Stump1	Y21STMPC01	New	Stump Creek near the mouth	45°47'08"	105°03'08"	TBD
06325500	Y19LPOWR01	Current	Little Powder River at the mouth near Broadus, MT	45°27'39"	105°19'39"	1,965
06326300	Y20MZPHC01	Historic	Mizpah Creek near Mizpah, MT	46°15'39"	105°17'36"	797
06326520	Y21PWDRR01	Historic	Powder River at the mouth near Terry, MT	46°44'15"	105°25'43"	13,512
06326000	Y21PWDRR03	Historic	Powder River near Mizpah, MT	46°15'00"	105°16'00"	12,132
06325650	Y21PWDRR04	Historic	Powder River near Powderville, MT	45°45'08"	105°05'15"	TBD
06324710	Y18PWDRR01	Historic	Powder River at Broadus, MT	45°25'37"	105°24'05"	8,748
Rosebud Creek Watershed						
06296003	Y14ROSBC01	Current	Rosebud Creek at the mouth near Rosebud, MT	46°15'53"	106°28'30"	1,302
06295250	Y14ROSBC02	Historic	Rosebud Creek near Colstrip, MT	45°46'03"	106°34'10"	799
06295110	Y14ROSBC03	Historic	Rosebud Creek at Kirby, MT	45°19'59"	106°59'10"	TBD
Tongue River Watershed						
06307600	Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"	470
06307570	Y15HNGWC02	Historic	Hanging Woman Creek below Horse Creek near Birney, MT	45°08'02"	106°29'00"	321
06307740	Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"	707
451732106085001	Y16OTTRC02	Historic	Otter Creek below Taylor Creek near Otter, MT	45°17'32"	106°08'50"	TBD
Pumpkin1	Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"	TBD
Pumpkin2	Y16PMPKC02	New	Pumpkin Creek approx. 1.6 miles upstream from the mouth	46°14'14"	105°42'53"	TBD
06307500	Y15TNGR01	Current	Tongue River at the TRR Dam near Decker, MT	45°08'29"	106°46'15"	1,770
06307616	Y16TNGR02	Historic	Tongue River at Birney Day School, Near Birney MT	45°24'42"	106°27'26"	2,621
06306300	Y15TNGR02	Current	Tongue River at the State Line near Decker, MT	45°00'32"	106°50'08"	1,477
Tongue River Reservoir						
TRR1	Y15TNGRR03	New	Tongue River Reservoir near the dam	45.12099	106.78092	TBD
TRR2	Y15TNGRR02	New	Tongue River Reservoir in the middle	45.10018	106.78454	TBD
TRR3	Y15TNGRR01	New	Tongue River Reservoir, south end	45.07010	106.7996	TBD
T&Y Irrigation Canal						
T&Y1	Y16TNYID01	New	T&Y canal near the 12-mile diversion dam	46°15'12"	105°44'55"	TBD
T&Y2	Y16TNYID02	New	T&Y Canal at the VA Cemetery bridge	46°22'45"	105°49'32"	TBD

TBD: To be determined

3.2 Water Chemistry

Monitoring and sample collection activities in the Tongue River, Powder River, and Rosebud Creek watersheds are anticipated to extend over at least 6 months. Monitoring over this time span allows for collection of data that encompasses temporal changes that may occur in the segments of interest. Monitoring during this interval will capture spring snowmelt, summer withdrawals, and evaporation. The timing of sampling efforts will be based on the following factors: (1) flow conditions, (2) weather conditions, (3) logistical considerations, and (4) sufficient temporal spacing of sampling. Montana DEQ protocols will be used for all water chemistry sampling events, and data will be recorded and submitted to Montana DEQ using the Site Visit Forms included in Appendix C.

Quality assurance and quality control (QA/QC) procedures for water chemistry samples at all sites will include the following:

- 10 percent of the samples will be field blanks.
- Daily calibration of flow meters and multimeters.
- Chain of custody forms.

3.2.1 Salinity and SAR

3.2.1.1 Data Gaps

Additional data are needed to determine if beneficial uses in the Tongue River, Powder River, and Rosebud Creek watersheds are impaired because of salinity or sodium adsorption ratio (SAR). There are few recent data for several of the 303(d) listed segments, and monitoring will fill any data gaps. Routine, synoptic water quality monitoring will include regularly scheduled grab samples to determine the following parameters.

- *Field Parameters* – Water temperature, electrical conductivity (EC), flow
- *Laboratory Parameters* – Total dissolved solids (TDS); dissolved ions including: calcium, magnesium, sodium, chloride, sulfate; SAR (calculated)

Grab samples will be obtained once per month from April through September at the stations shown in Table 3-2. EC data will be obtained during every site visit at every station in the monitoring schedule using a multimeter field unit (see Section 3.2.6). USGS will also monitor several sites for salinity, TDS, and SAR in the Tongue River, Powder River, and Rosebud Creek (see Table A-2 in Appendix A). These data, along with continuous EC sampling at stations 06324500 (Powder River at Moorhead), 06306300 (Tongue River at the state border), and 06307830 (Tongue River near Ashland), will complement the 2003 sampling program.

Table 3-2. Monitoring stations for the 2003 salinity, TDS, and SAR sampling program.

STORET ID	Site Type	Description	Latitude	Longitude
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y15HNGWC02	Historic	Hanging Woman Creek below Horse Creek near Birney, MT	45°08'02"	106°29'00"
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16OTTRC02	Historic	Otter Creek below Taylor Creek near Otter, MT	45°17'32"	106°08'50"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y20MZPHC01	Historic	Mizpah Creek near Mizpah, MT	46°15’39”	105°17’36”
Y21STMPC01	New	Stump Creek near the mouth	45°47'08"	105°03'08"
Y15TNGR01	Current (flow)	Tongue River at the TRR Dam near Decker, MT	45°08'29"	106°46'15"
Y14ROSBC02	Historic	Rosebud Creek near Colstrip, MT	45°46’03”	106°34’10”
Y14ROSBC03	Historic	Rosebud Creek at Kirby, MT	45°19'59"	106°59'10"
Y16TNYID01	New	T&Y canal near the 12-mile diversion dam	46°15'12"	105°44'55"
Y16TNYID02	New	T&Y canal at the VA Cemetery bridge	46°22'45"	105°49'32"

3.2.1.2 Source Assessment

There is not a good understanding of the sources of salinity and SAR in the Tongue River, Powder River, and Rosebud Creek watersheds. A multi-year study will be needed to fully determine contributions from various sources including the extent and contribution from irrigation under various conditions (rainfall, soil type, crop type). The different stages of the multi-year study are outlined below.

1) Conduct a land use analysis to determine the extent of irrigated land and the amount of irrigated water used.
2) Contact landowners and local Conservation Districts to determine the extent and type of irrigated land.
3) Contact state and local experts about irrigation as a source of salinity.
4) Identify sources using state and local contacts, GIS, and field surveys.
5) Field verify irrigated land information.
6) Monitor irrigation returns and segments of the river affected by irrigation.

Tasks one through five will be completed in 2003. Task six will be implemented in 2004. In 2004, one or two irrigation returns, and one or two river segments upstream and downstream of agricultural areas, will be monitored. EPA and DEQ will coordinate with local landowners to obtain permission and landowner cooperation. A multimeter, such as a YSI or Horiba unit, may be installed to obtain continuous EC and temperature samples at small specified intervals (e.g., hourly). Local precipitation at or near the gages will be checked daily in conjunction with this study, and the landowners will document irrigation practices. Field surveys of irrigation practices and irrigation returns will be conducted throughout all three watersheds in conjunction with the stream sampling plan.

3.2.2 Total Suspended Solids/Sediment

Additional data are needed to determine if beneficial uses in the Tongue River, Powder River, and Rosebud Creek watersheds are impaired because of total suspended solids. There are few recent data for several of the 303(d) listed segments, and monitoring will fill the identified data gaps. Routine, synoptic water quality monitoring will include regularly scheduled grab samples to determine the following parameters.

- *Field Parameters* – flow, turbidity, pebble counts
- *Laboratory Parameters* – total suspended solids (TSS)

Grab samples will be obtained once per month from April through September at the stations shown in Table 3-3. Sufficient data exist for other segments listed for TSS.

Table 3-3. Monitoring stations for the 2003 TSS sampling program.

STORET ID	Site Type	Description	Latitude	Longitude
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y15HNGWC02	Historic	Hanging Woman Creek below Horse Creek near Birney, MT	45°08'02"	106°29'00"
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16OTTRC02	Historic	Otter Creek below Taylor Creek near Otter, MT	45°17'32"	106°08'50"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y15TNGR01	Current	Tongue River at the TRR Dam near Decker, MT	45°08'29"	106°46'15"
Y16TNGR02	Historic	Tongue River at Birney Day School, Near Birney MT	45°24'42"	106°27'26"
Y14ROSBC01	Current	Rosebud Creek at the mouth near Rosebud, MT	46°15'53”	106°28’30”
Y14ROSBC02	Historic	Rosebud Creek near Colstrip, MT	45°46’03”	106°34’10”
Y14ROSBC03	Historic	Rosebud Creek at Kirby, MT	45°19'59"	106°59'10"
Y21STMPC01	New	Stump Creek near the mouth	45°47'08"	105°03'08"
Y20MZPHC01	Historic	Mizpah Creek near Mizpah, MT	46°15’39”	105°17’36”
Y21PWDRR01	Historic	Powder River at the mouth near Terry, MT	46°44’15”	105°25’43”
Y21PWDRR03	Historic	Powder River near Mizpah, MT	46°15’00”	105°16’00”
Y21PWDRR04	Historic	Powder River near Powderville, MT	45°45’08”	105°05’15”
Y18PWDRR01	Historic	Powder River at Broadus, MT	45°25’37”	105°24’05”

3.2.3 Temperature

Pumpkin Creek was listed for thermal modifications in 1996. A continuous temperature data logger will be installed in two segments of Pumpkin Creek to help characterize the water temperature of Pumpkin Creek on a daily basis. One data logger will be installed in a segment of the stream near the mouth with poor riparian characteristics (e.g., sparse woody vegetation) (Pumpkin1). A second data logger will be installed in an upstream segment of the river with good riparian conditions, approximately 1.6 miles upstream of the mouth (Pumpkin2). Two temperature data loggers will also be installed in both Otter Creek and Hanging Woman Creek (Table 3-4).

Temperature data loggers will be encased in PVC pipe and installed in the stream segments in April 2003. The USGS maintains a continuous temperature data logger at the Tongue River near the mouth at Miles City, MT (Station 06308500).

Table 3-4. Monitoring stations for the 2003 temperature sampling program.

STORET ID	Site Type	Description	Latitude	Longitude
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16OTTRC02	Historic	Otter Creek below Taylor Creek near Otter, MT	45°17'32"	106°08'50"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y16PMPKC02	New	Pumpkin Creek approx. 1.6 miles upstream from the mouth	46°14'14"	105°42'53"
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y15HNGWC02	Historic	Hanging Woman Creek below Horse Creek near Birney, MT	45°08'02"	106°29'00"

3.2.4 Metals

3.2.4.1 Data Gaps

Additional data are needed to determine if beneficial uses in the Tongue River, Powder River, and Rosebud Creek watersheds are impaired because of metals. There are few recent data for several of the 303(d) listed segments, and monitoring will fill the identified data gaps. Routine, synoptic water quality monitoring will include regularly scheduled grab samples to determine the following parameters.

- *Field Parameters* – Flow, pH
- *Laboratory Parameters* – Hardness; water column total recoverable (TR) and dissolved samples of: arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, silver, and zinc.

Grab samples for water column metals will be obtained once per month from April through September at the stations shown in Table 3-5.

Table 3-5. Monitoring stations for the 2003 metals sampling program.

STORET ID	Site Type	Description	Latitude	Longitude
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y16TNGR02	Historic	Tongue River at Birney Day School, near Birney MT	45°24'42"	106°27'26"
Y14ROSBC02	Historic	Rosebud Creek at Kirby, MT	45°19'59"	106°59'10"
Y14ROSBC03	Historic	Rosebud Creek near Colstrip, MT	45°46'03"	106°34'10"

3.2.4.2 Source Assessment

There is not a good understanding of the sources metals in the Tongue River, Powder River, and Rosebud Creek watersheds. The location of some potential sources of metals has been documented throughout the watershed. However, it is uncertain if these potential sources are contributing significant metal loads. In 2003, major potential sources of metals will be evaluated using GIS and state and local data.

3.2.5 Nutrients

3.2.5.1 Chemistry

Additional data are needed to determine if beneficial uses in the Powder River, Tongue River, and Rosebud Creek are impaired because of nutrients. There are few recent data for the Powder River and Rosebud Creek, and monitoring will fill the identified data gaps. Routine, synoptic water quality monitoring will include regularly scheduled grab samples to determine the following parameters.

- *Field Parameters* – Temperature, flow, dissolved oxygen
- *Laboratory Parameters* – total phosphorus (TP), soluble reactive phosphorus (SRP), nitrate plus nitrite (NO_2+NO_3), total Kjeldhal nitrogen (TKN), chlorophyll-*a*, total nitrogen (calculated)

Grab samples will be obtained once per month from April through September at the stations shown in Table 3-6. Nutrient and DO sampling will also occur to complement biological monitoring (see Section 3.3).

Table 3-6. Monitoring stations for the 2003 nutrient and DO sampling program.

STORET ID	Site Type	Description	Latitude	Longitude
Y21PWDRR01	Historic	Powder River at the mouth near Terry, MT	46°44’15”	105°25’43”
Y21PWDRR03	Historic	Powder River near Mizpah, MT	46°15’00”	105°16’00”
Y21PWDRR04	Historic	Powder River near Powderville, MT	45°45’08”	105°05’15”
Y18PWDRR01	Historic	Powder River at Broadus, MT	45°25’37”	105°24’05”
Y20MZPHC01	Historic	Mizpah Creek near Mizpah, MT	46°15’39”	105°17’36”
Y15TNGR01	Current (Flow)	Tongue River at the TRR Dam near Decker, MT	45°08'29"	106°46'15"
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y14ROSBC01	Current (Flow)	Rosebud Creek at the mouth near Kirby, MT	46°15’53”	106°28’30”
Y14ROSBC02	Historic	Rosebud Creek near Colstrip, MT	45°46’03”	106°34’10”
Y14ROSBC03	Historic	Rosebud Creek at Kirby, MT	45°19'59"	106°59'10"

3.2.5.2 Source Assessment

There is not a good understanding of the sources of nutrients in the Powder River and Rosebud Creek. Sources will be identified through a field survey, GIS analysis, and state and local contacts. The source assessment for nutrients is outlined below.

- Identify the type and extent of agricultural practices throughout the Rosebud Creek and Powder River watersheds. This will be done in conjunction with the salinity source assessment analysis described in Section 3.2.2.
- Contact landowners about fertilizer use, application rates, and practices.
- Locate and GPS potential point sources such as fisheries and wastewater treatment plants.
- Locate and GPS animal feeding operations (AFOs) and identify the type of facility.

The nutrient source assessment will begin in the summer of 2003 and will continue as part of the phased TMDL approach for nutrients in the Powder River and Rosebud Creek.

3.2.6 Multimeter Parameters

Measurements from a portable multimeter unit will be obtained at each site during the 2003 sampling program. EC, temperature, dissolved oxygen, turbidity, and pH measurements will be obtained during each sampling event to complement the grab samples, biological, and physical monitoring. The multimeter will be calibrated daily according to the specifications of the unit.

3.3 Biology

Biological data can help determine aquatic life impairments in a river. If impairments are found, specific indicator species can point to the suspected causes of impairment. Biological surveys will include periphyton and benthic macroinvertebrate sampling in accordance with EPA's Environmental Monitoring and Assessment Program (EMAP) protocols (EMAP 2002). Surveys will be conducted at the monitoring locations identified in Table 3-7 because there is a lack of current biological data for these streams. Biological data has been collected at several other sites throughout all three watersheds, and available data are summarized in the TMDL Status Reports.

Sampling will occur once at each station in July of 2003. Biological data will be collected in a reach defined as approximately 40 times the average width of the river, but not less than 150 meters and no greater than 500 meters. Reaches defined for biological sampling will be at or near current water quality monitoring stations. Temperature, flow, EC, DO, and pH will be sampled with a multimeter at the time of all biological sampling.

Water chemistry grab samples will be collected at each biological monitoring site at the time of the biological monitoring. Data will be collected so that the results from the biological sampling can be correlated to in-stream water concentrations of metals, nutrients, dissolved oxygen, and suspended solids. Water quality monitoring will include grab samples to determine the following parameters:

- *Field Parameters* – Temperature, flow, dissolved oxygen, pH, salinity EC
- *Laboratory Parameters* – nutrients (total phosphorus), SRP, nitrate plus nitrite ($N0_2$+$N0_3$), total Kjeldhal nitrogen (TKN), total nitrogen (calculated); hardness (calculated); water column total recoverable (TR) and dissolved samples of: arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, silver, and zinc; total suspended solids.

Biology and water chemistry grab samples will be obtained in July 2003 at the stations shown in Table 3-7.

Table 3-7. Monitoring stations for the 2003 biological sampling program.

STORET ID	Site Type	Description	Lat	Long
Y15HNGWC01	Historic	Hanging Woman Creek near Birney, MT	45°17'57"	106°30'28"
Y15HNGWC02	Historic	Hanging Woman Creek below Horse Creek near Birney, MT	45°08'02"	106°29'00"
Y16OTTRC01	Historic	Otter Creek at Ashland, MT	45°35'18"	106°15'17"
Y16OTTRC02	Historic	Otter Creek below Taylor Creek near Otter, MT	45°17'32"	106°08'50"
Y16PMPKC01	New	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam fishing access	46°14'49"	105°44'54"
Y16PMPKC02	New	Pumpkin Creek approx. 1.6 miles upstream from the mouth	46°14'14"	105°42'53"
Y19LPOWR01	Current	Little Powder River at the mouth near Broadus, MT	45°27'39"	105°19'39"
Y19LPOWR02	New	Little Powder River near Biddle, MT	TBD	TBD

TBD – to be determined

3.3.1 Macroinvertebrates

Benthic macroinvertebrate sampling will be conducted at the stations shown in Table 3-7 in accordance with the EMAP SOP. Sampling will be coordinated to avoid periods of extremely high flow which can be unsafe and potentially disruptive to a macroinvertebrate system. Additional guidance from the EMAP SOP is shown below. The procedures for reach-wide, wadable, low gradient streams will be followed. Samples will be collected at each of the eleven cross-section transects established A habitat assessment will also be conducted at the time of sampling using the Montana Habitat Assessment Field Data Sheet.

> *A kick net sample is collected at each of eleven cross-section transects (established after the site is selected). Care should be taken to sample from a riffle that is as typical as possible for the stream type especially when it is not possible to use locally-generated reference data. It is best to avoid sampling near bridges, or crossings unless the purpose of the study is to examine the effects of these on the stream. There is evidence that the presence of lakes or impoundments on streams and rivers affects benthic invertebrate community composition; therefore sampling sites should be located as far from these as is practical. Sampling bedrock or large-boulder dominated riffles is best avoided, if practical.*

Data analysis will use provisional criteria established by DEQ and draft metrics developed by Montana State University.

3.3.2 Periphyton

Periphyton sampling will be conducted at the stations shown in Table 3-7 in accordance with the EMAP SOP. Sampling will be coordinated to avoid periods of extremely high flow which can be unsafe and potentially disruptive to a periphyton system. Additional guidance from the EMAP SOP is shown below. The procedures for wadable, low gradient streams will be followed. Sites will be located at or near the macroinvertebrate and water chemistry sampling sites.

> *Although stream periphyton may be assessed anytime of the year, the recommended time is summer (June 21 to September 21). This is a time of stable flows and peak periphyton diversity and standing crop in most Montana streams. Summer is also the season most amenable for field work in Montana and the season during which most reference data have been collected. High flows and turbid waters should be avoided because they limit access to and obscure visibility of the stream bottom. Assessments should be delayed for at least two weeks following high, bottom-scouring streamflows to allow for recolonization by algae and succession to a mature periphyton community. It may be necessary to sample outside the summer period to coincide with flows in ephemeral or dewatered streams, or to track seasonal changes in the biointegrity. When monitoring for trends from year to year, minimize the between-year variance by performing the assessments on or about the same date each year.*

3.4 Weather

Records from the nearest weather stations will be used to monitor local weather for the watersheds of interest. If a local weather station is not found that can provide the appropriate information, then an optional weather station capable of logging parameters such as temperature, barometric pressures, wind speed, precipitation, dew point, or solar radiation may be deployed. Precipitation data is currently available from USGS gages 06326500 (Powder River at Locate, MT) and 06308500 (Tongue River at Miles City, MT).

3.5 Flow

Instantaneous flows will be obtained during all sampling events with a Marsh-McBirney flow meter. Up to 20 cross sectional measurements will be made at each site to insure accurate flow readings with the meter. Standard calibration procedures for the meter will be followed each day. Some monitoring events will occur at USGS instantaneous flow gages (see Table A-3 in Appendix A). If possible, instantaneous flows will be obtained from the gage, real-time internet data, or by contacting USGS personnel.

3.6 Physical Sampling

NRCS has completed extensive riparian habitat assessments for the Tongue River and Powder River (NRCS, 2001a, 2001b, 2002a, 2002b). Additional physical stream data may be collected in the Tongue River and Powder River watersheds as part of the 2003 sampling program if needed. Physical stream data is currently not available for Rosebud Creek, and data will be collected in 2003 to fill any data gaps.

Physical surveys will include assessments of the instream habitat quality, near stream riparian habitat quality, and stream discharge. Stream discharge measurements will be conducted at all of the synoptic water quality sampling locations. Transects for the assessment will be established at evenly spaced intervals over the length of the reach (40 times the stream width) for up to five transects per reach. Additional detail on establishing a reach as well as the number and spacing of transects is provided in the Stream Channel Reference Sites: An Illustrated Guide to Field Technique (USFS, 1994). The physical habitat quality assessment combines measurement data with professional judgments and ocular estimates of different characteristics of the channel, its morphology, hydrology, substrate types and distributions, bank conditions, cover conditions, and riparian qualities, among other features. To complete this assessment, the following data will be collected:

- Measurements of stream width, depth, erosion potential, bank slope, bank stability, canopy cover, habitat types, substrates dominance and types, upper bank vegetation buffer width, and instream cover types.
- Primary attributes - habitat types, number of riffles, pool to riffle ratios, dominant substrate type (d50), percent gravel or larger, algae/macrophytes, instream cover types, and percent instream cover
- Secondary attributes - stream bends, channel obstructions/modifications, channel flow status, stream width, stream depths and velocity.

- Tertiary attributes - riparian zone, natural vegetative buffer, aesthetics, percent riparian vegetation, bank slope, bank erosion, tree canopy, dominant vegetation and width of buffer.

Because of the nature of the survey, physical surveys will be conducted where there is landowner permission and reasonable access.

4.0 TONGUE RIVER RESERVOIR MONITORING

Additional data are needed to determine if beneficial uses in the Tongue River Reservoir are impaired because of nutrients, organic enrichment, low dissolved oxygen, algal growth/chlorophyll-a, and total suspended solids. Monitoring in the reservoir will be conducted in 2003 from April (lake thaw) to September (lake freeze). New and current river sampling sites will be used to monitor the inflow and outflow to the reservoir. The Tongue River Reservoir sampling sites are shown below.

- Tongue River inflow – USGS station 06306300 (Tongue River at the WY-MT state line).
- Tongue River Reservoir outflow – USGS station 06307500 (Tongue River at the Tongue River Dam near Decker, MT).
- Tongue River Reservoir – riverine zone.
- Tongue River Reservoir – transition zone.
- Tongue River Reservoir – lacustrine zone.

Routine, synoptic water quality monitoring at the Tongue River outflow site (station 06307500) will include regularly scheduled grab samples for the parameters shown below. Grab samples will be obtained once per month. USGS will monitor water chemistry data at the Tongue River Reservoir inflow site (station 06306300).

- *Field Parameters* – Temperature, dissolved oxygen, pH, EC.
- *Laboratory Parameters* – total phosphorus (TP), soluble reactive phosphorus (SRP), nitrate plus nitrite (NO_2+NO_3), total Kjeldhal nitrogen (TKN), total nitrogen (TN) (calculated), ammonia, chlorophyll-*a*, total suspended solids; total dissolved solids (TDS); dissolved ions including: calcium, magnesium, sodium, chloride, sulfate; SAR (calculated)

Reservoir sampling will include water column profiles and grab samples at various depths at all three stations. The sampling plan is outlined below. Samples will be obtained once per month, and three different depths will be obtained at each site. The depth of each sample will depend on lake stratification conditions at the time of sampling.

- Water column profiles (surface sample and then one meter intervals) – temperature, dissolved oxygen, pH, and conductivity.
- Water column grab samples (one meter below the surface, midpoint, and one meter from the bottom) – total phosphorus, soluble reactive phosphorus, ammonia, nitrate, nitrite, total Kjeldhal nitrogen, total nitrogen, and total suspended solids.
- Secchi disk depth at all three stations.
- Composite sample of chlorophyll-*a* in the euphotic zone at all three stations.

5.0 EQUIPMENT

Equipment potentially needed for all data gathering efforts are included in the tables below.

Table 3-8. General items.

QTY	ITEM
10	Soft (#2) lead pencils
10	Fine-tip indelible markers
2	pkg. Clear tape strips
1	rolls Plastic electrical tape / Duct tape
1	Knife, pocket, with at least two blades
1	Scissors
1	Pocket-sized field notebook (optional)
1	pkg. Kim wipes in small self-sealing plastic bag
1	copy Field operations and methods manual
1	Map with AX-site@ marked
1	Field notebook
2	Clipboards
2	boxes rubber gloves
10	Shipping airbills and adhesive plastic sleeves

Table 3-9. Water chemistry / monthly sampling supplies.

Qty/site	ITEM
1	Cooler for transporting samples
---	Bags of ice
2	Safety glasses
1	Sample containers (supplied by lab)
1	Sample preservatives (supplied by lab)
1	Clear tape strip for covering label
1	GPS receiver and operating manual (set to NAD 27; measure in decimal degrees)
4	Extra batteries for GPS
1	Digital camera
1	Horiba meter (for measuring DO, EC, temperature, pH)
1	DO repair kit (membranes, filling solution)
2	Rinse bottles
1	Acid waste container labeled Awaste@ for disposing of preservatives
1	Carboy of deionized water
1	500 mL bottle of ph calibration solutions (2 point calibration)
1	500 mL bottle of conductivity calibration solution
1	Site visit form to record results
1	Sheet of site visit codes (supplied by DEQ)
1	Velocity meter (Marsh Mc-Birney Model 201) with operating manual
1	Top-set wading rod (metric scale) for use with meter
2	Pieces of rebar to attaching measuring tape
2	Measuring 200m and 100m tapes (meters and inches)
1	Discharge form (supplied by DEQ)
1	Datalogger (Hobo)
1	Stabilizing device (concrete, rebar)
1	Items to download from recorder?
1	PVC to protect datalogger

Table 3-10. Equipment for lake sampling.

QTY	ITEM
1	Boat
1	Depth Finder
1	GPS Unit
4	Spare batteries for the GPS
1	Gloves
1	Cubitainer, 4-L (1 per site)
	Ice in self-contained bags
1	Cooler to store samples
1	Van Dorn with 25 foot line and messenger
1	1-L wash bottle (with deionized water)
1	Horiba meter with 25 foot cord
1	Lake sample form per site
1	Chlorophyll box:
1	Filter apparatus with filter installed
1	Hand pump with tubing
1	Box of filters (Whatman GFF) in self-sealing plastic bag
1	Forceps in bag with filters
1	Graduated cylinder (100 mL)
1	Graduated cylinder (250 mL)
1	Squares of foil in plastic bag
1	Secchi disk

Table 3-11. Equipment and supplies for periphyton sampling.

QTY	ITEM
1	Large funnel (15-20 cm diameter)
1	12-cm2 area delimiter (3.8 cm diameter PVC pipe, 3 cm tall)
1	Stiff-bristle toothbrush with handle bent at 90^{o} angle
1	1-L wash bottle labeled ASTREAM WATER@
1	1-L wash bottle labeled for and containing deionized water
1	500-mL plastic bottle (with volume markings) for composite index samples, labeled APERIPHYTON COMPOSITE SAMPLE@
1	35-60 mL catheter-tipped plastic syringe
4	50-mL screw-top centrifuge tubes
1	box Glass-fiber filters for chlorophyll and biomass samples
1	pair Forceps for filter handling
1	25-mL or 50-mL graduated cylinder
1	Filtration unit, including filter funnel, cap, filter holder, and receiving chamber
1	Hand-operated vacuum pump and clear plastic tubing
1	Small lightproof plastic bags for storing chlorophyll and biomass samples
2	Self-sealing plastic bags for chlorophyll and biomass samples
4	mL 10% formalin or Lugols solution for ID/Enumeration samples
1	Small syringe or bulb pipette for dispensing formalin
1	pair Chemical-resistant gloves for handling formalin
1	pair Safety glasses for use when handling formalin
2	2 sets Sample labels (4 per set) with the same barcode ID number
1	Sample Collection Form for site (Algae Form)

Table 3-12. Equipment and supplies for benthic macroinvertebrate sampling.

QTY	ITEM
1	Modified kick net (D-frame with 500 µm mesh) and 4-ft handle (Wildco #425-C50)
1	Spare net(s) and/or spare bucket assembly for end of net
2	Watch with timer or a stopwatch
1	Sieve with 500 µm mesh openings
1	Sieve-bottomed bucket, 500 µm mesh openings
2	pr. Watchmakers= forceps
1	Wash bottle, 1-L capacity labeled ASTREAM WATER@
1	Small spatula, spoon, or scoop to transfer sample
1	Funnel, with large bore spout
___	Sample jars, HDPE plastic with screw caps, 500-mL and 1-L capacity, suitable for use with ethanol
2	2 gal 95% ethanol, in a proper container
2	pr. Rubber gloves, heavy rubber
1	Cooler (with suitable absorbent material) for transporting ethanol and samples
2	Benthic sample labels
6	Blank labels on waterproof paper for inside of jars
1	Sample Collection Form for site (RBP Assessment Form)

Table 3-13. Equipment and supplies for physical habitat sampling.

QTY	ITEM
1	Fisherman=s vest with lots of pockets
1	50-meter tape measure (should have for discharge)
1	Clinometer
1	Measuring tape for measuring sinuosity (should have for discharge)
1	Measuring rod
3	Physical habitat forms (slope, sinuosity, Rosgen classification) from DEQ
1	Rosgen book for reference

Table 3-14. Personal gear.

QTY	ITEM
1	Pair Chest waders
1	Sunglasses
1	First aid kit
1	Rain gear
1	Fisherman=s vest for physical habitat characterization
1	Day pack
1	Insect repellent, sunscreen
1	Patch kit for waders

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APPENDIX A – MONITORING ACTIVITIES AND FREQUENCIES

Table A-1. Sampling activities for 2003 at the proposed monitoring locations.

Site ID	Site Description	TSS	TDS	Ca, Mg, Na, Cl, SO_4	SRP	TP, NN, TKN	Chl-a	Dissolved Metals	Total Metals	Continuous Temp	Multimeter	Macro	Periphyton	Physical	Flow
Powder River Watershed															
Y21STMPC01	Stump creek near the mouth	M	M	M							M				M
Y19LPOWR01	Little Powder River at the mouth near Broadus, MT											X	X	X	X
Y20MZPHC01	Mizpah Creek near Mizpah, MT	M	M	M	M	M	X				M				M
Y21PWDRR01	Powder River at the mouth near Terry, MT	M			M	M	X				M				M
Y21PWDRR03	Powder River near Mizpah, MT	M			M	M	X				M				M
Y21PWDRR04	Powder River near Powderville, MT	M			M	M	X				M				M
Y18PWDRR01	Powder River at Broadus, MT	M			M	M	X				M				M
Rosebud Creek Watershed															
Y14ROSBC01	Rosebud Creek at the mouth near Rosebud, MT	M			M	M	X				M				M
Y14ROSBC02	Rosebud Creek near Colstrip, MT	M	M	M	M	M	X	M	M		M				M
Y14ROSBC03	Rosebud Creek at Kirby, MT	M	M	M	M	M	X	M	M		M				M
Tongue River Watershed															
Y15HNGWC01	Hanging Woman Creek near Birney, MT	M	M	M	M	M	X	M	M	C	M	X	X	X	M
Y15HNGWC02	Hanging Woman Creek below Horse Creek near Birney, MT	M	M	M						C	M				M
Y16OTTRC01	Otter Creek at Ashland, MT	M	M	M	M	M	X	M	M	C	M	X	X	X	M
Y16OTTRC02	Otter Creek below Taylor Creek near Otter, MT	M	M	M						C	M				M
Y16PMPKC01	Pumpkin Creek near the mouth at the Tongue River 12-Mile Dam Fishing access	M	M	M	M	M	X	M	M	C	M	X	X	X	M
Y16PMPKC02	Pumpkin Creek approx. 1.6 miles upstream of Hwy. 332									C					
Y16TNGR02	Tongue River at Birney Day School, near Birney MT	M						M	M		M				M
Y16TNGR01	Tongue River at the TRR Dam	M	M	M	M	M	X				M				M
Y15TNGR02	Tongue River at the state line near Decker, MT						X				M				M
Tongue River Reservoir															
Y15TNGRR03	Tongue River Reservoir near the dam (3 depths)	M	M	M	M	M	M				M				
Y15TNGRR02	Tongue River Reservoir in the middle (3 depths)	M	M	M	M	M	M				M				
Y15TNGRR01	Tongue River Reservoir, south end (3 depths)	M	M	M	M	M	M				M				
T&Y Canal															
Y16TNYID01	T&Y canal near the 12-mile diversion dam		M	M							M				M
Y16TNYID02	T&Y Canal at the VA Cemetery bridge		M	M							M				M

M – Monthly; C – Continuous; X – Once

Table A-2. Summary of the 2003 USGS sampling program.

Station Number	Station Name	Continuous Data				2003 Water Chemistry
		Discharge	Temperature	EC	Precipitation	
06325500	Little Powder River at the mouth near Broadus, MT					Y
06324970	Little Powder River above Dry Creek near Weston, WY	Y				Y
06326500	Powder River near Locate, MT	Y			Y	Y
06324500	Powder River at Moorhead, MT	Y		Y		Y
06317000	Powder River at Arvada, WY	Y				Y
06298000	Tongue River near Dayton, WY	Y				Y
06306300	Tongue River at the MT-WY border	Y		Y		Y
06307500	Tongue River at the TRR Dam near Decker, MT	Y				
06307616	Tongue River at Birney Day School, near Birney MT	Y				
06307830	Tongue River below Brandenburg Bridge near Ashland, MT	Y		Y		Y
06308500	Tongue River at Miles City, MT	Y	Y		Y	Y
06296003	Rosebud Creek at the mouth near Rosebud, MT	Y				Y
06295250	Rosebud Creek near Colstrip, MT	Y				
06295113	Rosebud Creek at the reservation boundary near Kirby, MT	Y				

Table A-3. Timeline of proposed monitoring activities and frequency of monitoring activities.

Sampling Type	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Extended (2004-2006)
Salinity/TDS/SAR	1	1	1	1	1	1				
TSS	1	1	1	1	1	1				
Temperature	C	C	C	C	C	C				
Metals	1	1	1	1	1	1				
Nutrients/DO	1	1	1	1	1	1				
Macro				1						
Periphyton				1						
Salinity Source Assessment	C	C	C	C	C	C	C	C	C	C
Nutrients Source Assessment	C	C	C	C	C	C	C	C	C	C

C – Continuous

APPENDIX B – MONITORING LOCATIONS

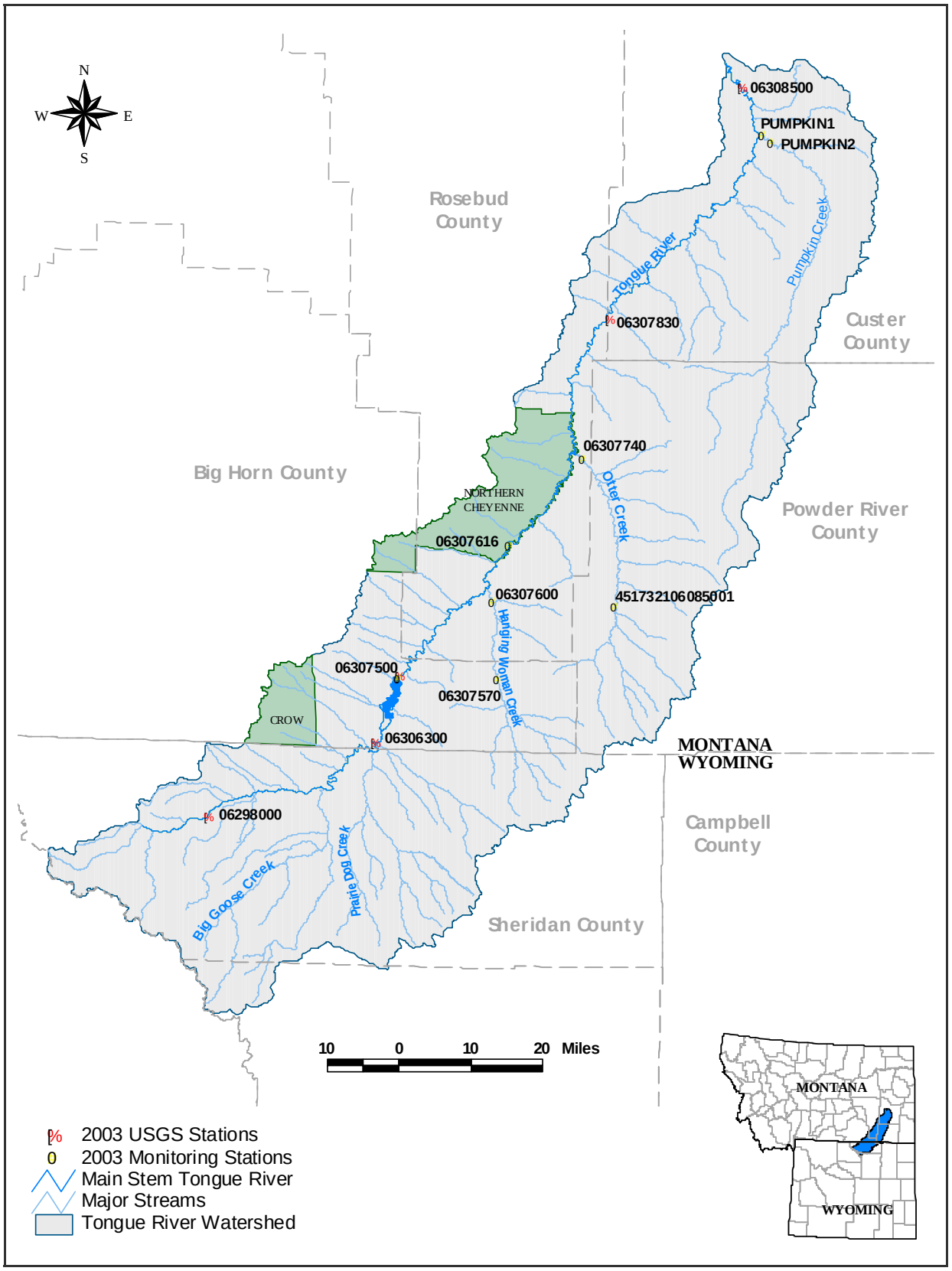

Figure B-1. Location of the 2003 Tongue River watershed monitoring stations.

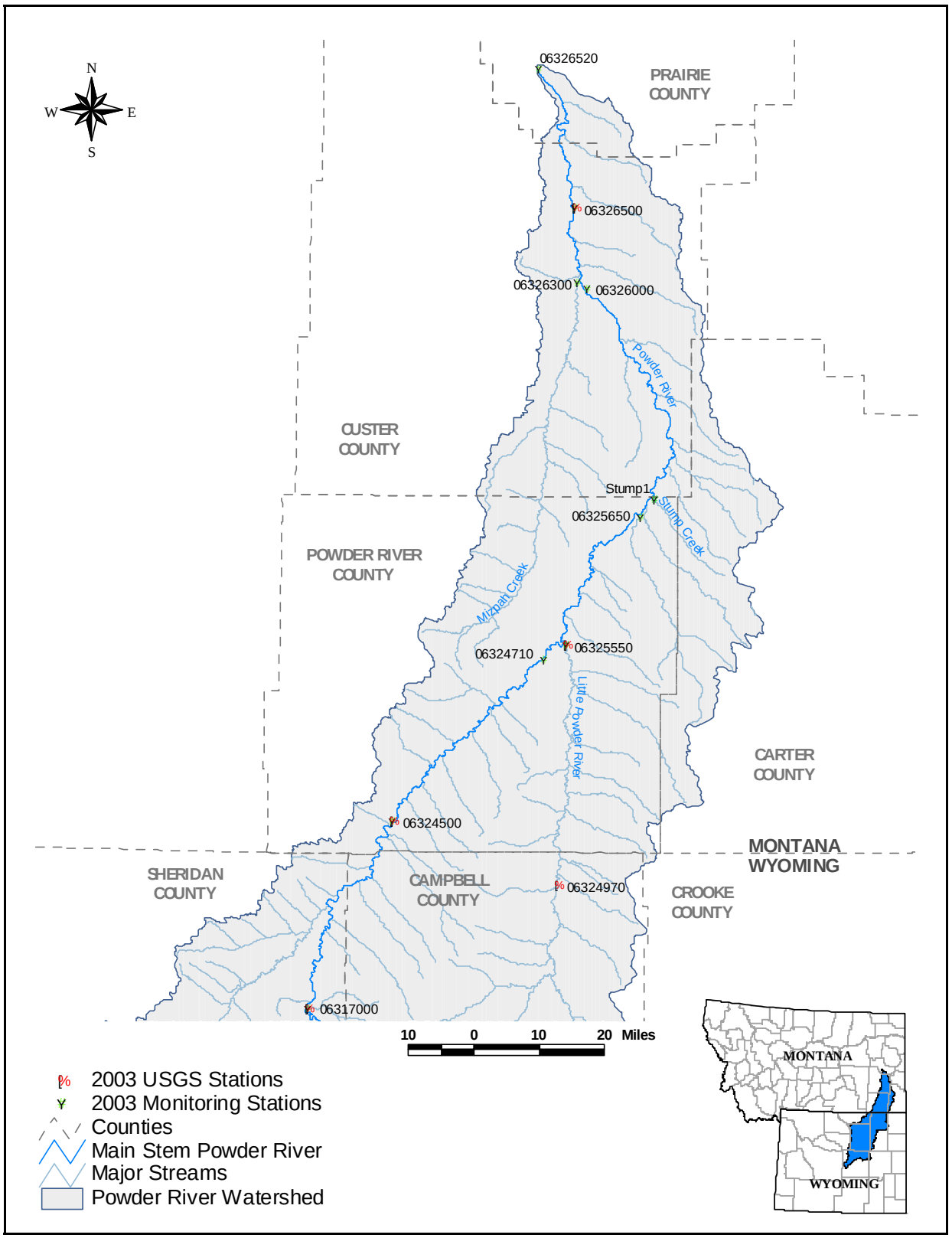

Figure B-2. Location of the 2003 Powder River watershed monitoring stations.

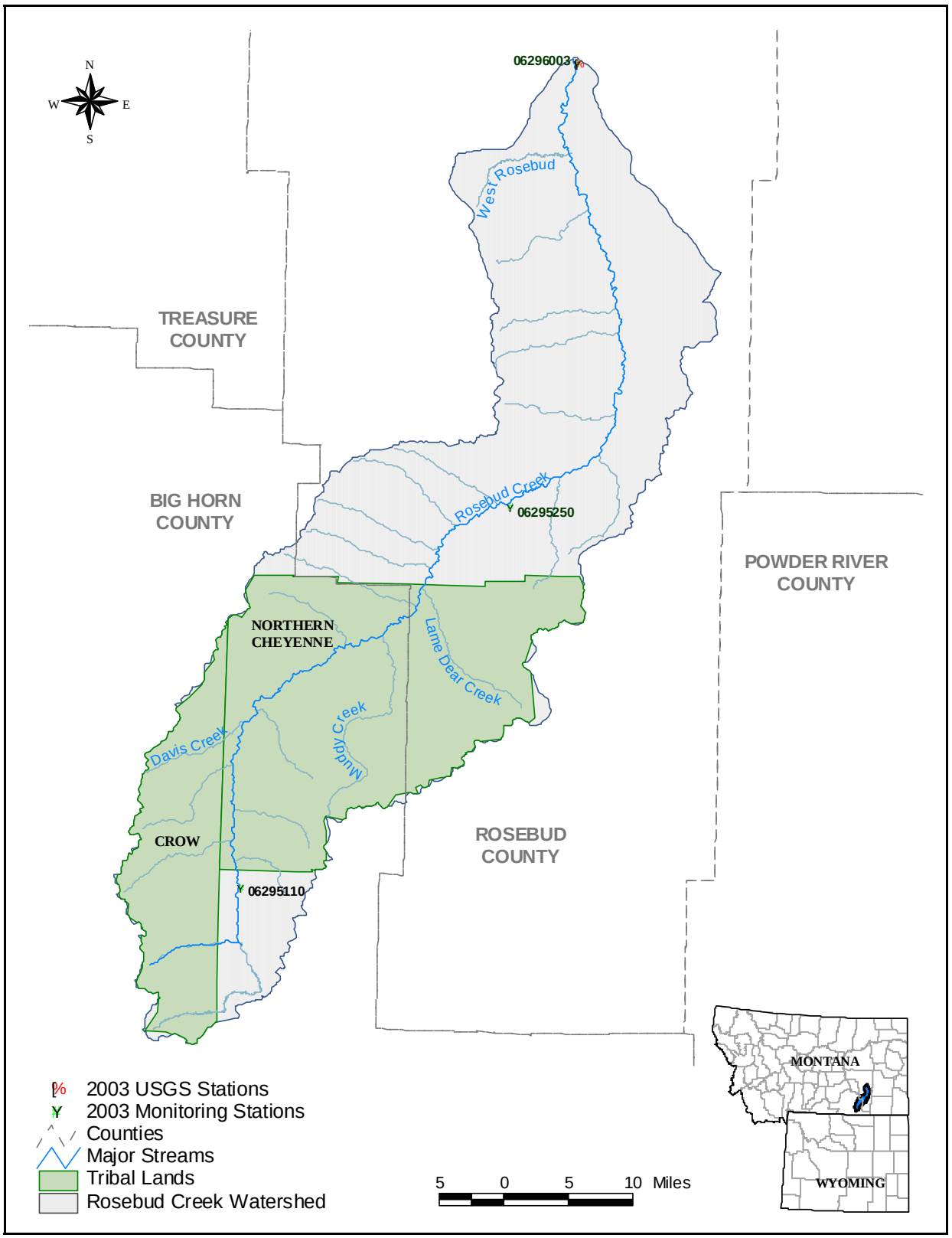

Figure B-3. Location of the 2003 Rosebud Creek watershed monitoring stations.

APPENDIX C – DATA FORMS

Place Site Visit Label Here

Site Visit Form

(One Station per page)

STORET Project ID: _____

Trip ID: _____ Date: _____

Personnel: _____

Waterbody Name _____ County _____ HUC _____

Station ID _____ Visit # _____ Location _____

Lat _____ Long _____ Verified? ☐ By _____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? _____

Samples Taken:			**Sample ID/File Location:**	**Sample Collection Procedure**
Water	☐	Nutrients ☐ Metals ☐ Commons ☐		GRAB
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☐			CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:**
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	**Time:**	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =		µmho/cm
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration:	Kick Length (Ft.):
Site Visit Comments:	

Revised 3/2003 DMA

Field Data Sheet Instructions

- Place a Site Visit Code label in the upper left corner.
- STORET Project ID: Enter the Project ID assigned by the Data Management Section. If you do not know this information contact Data Management.
- Trip ID: Enter the Trip ID assigned by the Data Management Section. If you do not know this information contact Data Management.
- Date: Enter the date of the station visit.
- Personnel: Enter the name(s) of the personnel sampling
- Waterbody Name: Enter the name of the waterbody such as “Missouri River”.
- County: Enter the county in which the station resides
- HUC: Enter the HUC the station falls within
- Station ID: Enter the STORET Station ID the Data Management Section established for the site.
- Visit #: Leave this field blank.
- Location: This is an opportunity to expand on the waterbody name. Such as “upstream from bridge on Forest Service road 100” rather than just “Coal Creek”. When the station details are entered into STORET a combination of the Waterbody Name and Location will be used for the Station Name.
- Lat/Long: Latitude and Longitudes should be obtained in decimal degrees through a GPS unit reading NAD27 whenever possible. If this is not possible a lat/long obtained through map interpolation or a mapping program is acceptable as long as the map datum (NAD27, WGS84 etc.) the website uses is circled on the field form. If the lat/long is derived from a topographic map the map scale (1:24,000, etc.) should be noted on the form. Also note in the Comments field the reason a GPS reading was unavailable.
- Verified: Latitudes and Longitudes should always be verified upon return from the field. They can be verified by plotting them on a paper map or using a mapping website. Once the lat/long has been verified check the “Verified” box and put your initials in the space next to “By”.
  If when verifying the lat/long it is determined that the measurement must be corrected please note the correct lat/long in the comment field along with what method was used to arrive at this “corrected” lat/long. Do not erase or dispose of the original Lat/Long reading. Draw a single line through the original lat/long and put your initials. If a map is

used to generate the lat/long the map scale, such as 1:250,000, and the map datum, such as NAD27 are needed.

- GPS Datum: Circle the GPS Datum your GPS unit is set to read. Data management would like to have all GPS units set to read NAD27 for consistency.

- Lat/Long obtained by method other than GPS? Check Yes or No. If Yes describe what method was used to obtain the lat/long. If a map was used note the map scale. If a mapping website was used note the datum the website uses.

- Samples Taken: Check the boxes next to each type of sample if you collect that type of sample during your station visit. Also check off the type of habitat assessments you complete during your station visit.

- Sample ID/File Location: Write the Activity ID (Sample ID) for each of the samples you collect in the field. Alternately, if the habitat assessments are processed into an electronic format note the file location.

- Sample Collection Procedure: Circle the sample collection procedure you used to obtain each sample type. The Sample Collection Procedures listed on the form are DEQ procedures. To ensure you are using the correct DEQ procedures check the MDMB SOP manual.

- Field Measurements: record your field measurements in the spaces provided

- Comments: Use the “Comments” field to record comments about the GPS reading, any additional samples that were taken such as bacteria, etc.

CHANNEL CROSS-SECTION

Date: _____ Site Visit Code: _____

Waterbody: MIZPAH CREEK Site ID: Y20MZPHC01

Personnel: _____ Trip ID: 2003-YELS

Project ID: TMDL-Y20 Survey Equipment: (Laser/Other): _____

	STATION	DEPTH	CELL WIDTH	MEAN CELL DEPTH	CELL AREA	NOTATION
	(reading taken from the tape across the cross section)	(vertical distance from streambed to elevation @ bkf)	(e.g.: STATION 2 -STATION 1)	e.g.: 1/2(DEPTH 1+ DEPTH 2)	(CELL WIDTH X MEAN CELL DEPTH)	*(e.g.: Lbkf, LWE,THWG,RWE, Rbkf)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
		TOTAL CROSS-SECTIONAL AREA:				

* Notations: Lbkf: Left bankfull, Rbkf: Right bankfull, LWE: Left Water Edge, RWE: Right Water Edge, THWG:Thalweg

AQUATIC PLANT FIELD SHEET

Date: Site Visit Code:

STORET Station ID:

Waterbody:

Personnel:

Purpose: The purpose of completing this form is to estimate the percent of wetted substrates at the sampling site covered by each of the major categories of aquatic plants, to record the relative amount of accumulated growth in each category, and to note the general color and condition of plants in each category. This information will help to describe the health and productivity of the aquatic ecosystem, define nuisance aquatic plant problems, identify potential sources and causes of pollution, and document changes in the plant community over time.

Type of plant growth	Cover (%)	Amount of growth	Color	Condition
Microalgae				
Macroalgae				
Mosses				
Macrophytes				
Bare substrate				
Total	100 %			

Substrates present (please rank):

rock: _____

wood: _____

sediment: _____

other (list): _____

1) _____

2) _____

3) _____

4) _____

5) _____

Explanation and Definitions

Cover: Estimate the percent of wetted substrate area colonized by each of the plant categories listed, and the percent area that is not colonized by any plants (see **Bare Substrate**, overleaf). Also, rank the types of substrates that are available for colonization by plants (1 = substrate accounting for the most area, etc.).

Amount: Record the relative amount of plant growth in each category as being **light**, **moderate**, or **heavy**. **Light** growth barely covers the substrate surface and is not immediately evident. **Heavy** growth extends almost to the water surface or beyond. **Moderate** growth is intermediate between light growth and heavy growth.

Color: The colors of aquatic plants are clues to their identity and to the health of aquatic ecosystems. Plant colors may span the spectrum of hues in the rainbow (see **Microalgae** below). Record the predominant color of the plants in each of the categories present.

Condition: Aquatic plants go through seasonal cycles of growth, maturity, and decay. The condition of a plant or group of plants will indicate the stage of this seasonal cycle. **Growing** plants show new growth and bright colors. **Mature** plants are larger but have more subdued colors because of age, epiphytes and sediment deposits. **Decaying** plants display a loss of both pigmentation and physical integrity. Enter **growing**, **mature**, or **decaying**.

Microalgae: Microalgae are microscopic algae appearing as pigmented accumulations attached to or resting upon submerged surfaces. This category commonly includes diatom "slimes" and films of green, blue-green, or euglenoid algae in depositional areas. Colors may range through shades of yellow, red, brown, green, blue and black. Included here are accumulations of "sewage fungus" (dark-gray) below sources of organic pollution, "yellow boy" (yellow-orange) below mine adits, and iron bacteria (orange-brown) in groundwater seeps and springs.

Macroalgae: Macroalgae are macroscopic algae whose individual plants or colonies are visible to the unaided eye. Macroalgae may be free-floating, or they may be attached to or resting upon submerged surfaces. Examples of macroalgae include filamentous growth forms (*Cladophora*, *Spirogyra*, *Oedhrix*), plant-like algae with leaf-like structures (*Chara*, *Nitella*), compact round or flattened colonies (*Nostoc*, *Rivularia*), gelatinous masses (*Chaetophora*, *Tetraspora*), and short, tubular strands (*Lemanea*). Color is highly variable, as it is with the microalgae.

Moss: Mosses are primitive plants that are intermediate in complexity between algae and higher plants. Mosses are common in cold-water habitats in western Montana. Mosses are typically green in color; the shade of green varies with plant vigor and the amount of sediment accumulation.

Macrophytes: Macrophytes or "higher plants" are distinguished from algae and mosses by their larger size and by the presence of true leaves, roots and flowers. Rooted macrophytes typically colonize areas of sediment deposition. Macrophytes may be free-floating (duckweed), submergent (pondweed), or emergent (cattails, bulrush, water lily).

Bare Substrate: Substrates may be void of plant growth because of toxic or sterile conditions or because of recently scoured or unstable substrates. Rocks in mountain lakes and streams may appear to be barren at first glance, but closer examination often reveals a very thin film of diatoms (microalgae) that feels slippery or slimy to the touch. Similarly, nearshore sediment deposits that have not been disturbed for several days will usually develop a film of microalgae. Examine these substrates closely.

SUBSTRATE DEQ/MDM

Date: **Site Visit Code:**

Waterbody: **STORET Station ID:**

Personnel:

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	*Characteristic Group: PEBL-CNT*		
						Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock	BOULDERS	> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	